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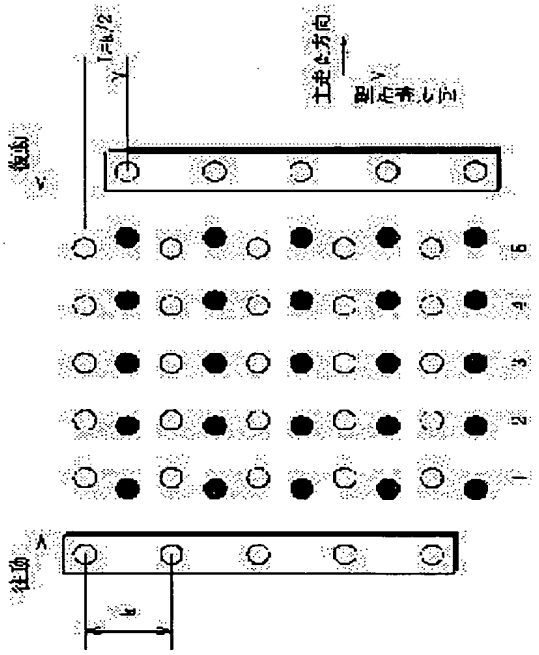
(54) PRINTER ADJUSTING SHIFT OF DOT FORMING POSITION

(57)Abstract:
PROBLEM TO BE SOLVED: To enhance image quality by reducing shift of dot forming position.
SOLUTION: After dots are formed in an ink jet printer during going stroke of main scan, sub-scan is performed at a feed rate equal to one half of the nozzle pitch k to form dots of returning stroke thus printing a test pattern where both dots are arranged alternately in the sub-scan direction without being overlapped. When the dot forming timing of going and returning strokes is correct, a dot array is formed to extend in line in the sub-scan direction and small irregularities are formed when the dot forming timing is shifted. With such a test pattern, the dot forming timing can be adjusted easily with high accuracy based on the linearity of dot array. When the dot pitch is too short to cause overlap of dots in the sub-scan direction, a test pattern where the dots do not touch each other is formed by using the nozzles while decimating.



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CLAIMS

[Claim(s)]
[Claim 1] By the printing section which forms a dot using two or more dot formative elements from which the position of the direction of vertical scanning differs, performing horizontal scanning and vertical scanning It is the print control unit which generates the printing control data for making the test pattern which detects the position gap between two or more dots which drive the aforementioned dot formative element at a different stage, and are formed in the same pixel print. In the conditions by which two or more aforementioned dots are formed in two or more pixels from which the aforementioned test pattern differs in the position of the same [the position of main scanning direction], and the direction of vertical scanning, and the range at least of a part The print control unit which is the pattern which fulfills the conditions into which the dot formed between the dots formed at the stage of 1 at other stages is inserted.
[Claim 2] It is the print control unit which is the pattern which detects a position gap of the dot which it is a print control unit according to claim 1, and the aforementioned printing section is the printing section which can form a dot in the both sides at the time of **** of horizontal scanning and double action, and is formed at the time of the dot in which the aforementioned test pattern is formed at the time of ****, and double action.
[Claim 3] It is the print control unit which is a print control unit according to claim 1, and is the pattern which the aforementioned printing section is equipped with the dot formative element after having been arranged by the direction of vertical scanning, and main scanning direction two-dimensional, and detects a position gap of the dot in which the aforementioned test pattern is formed of the dot formative element from which the position of main scanning direction differs.

[Claim 4] It is a print control unit according to claim 1, the aforementioned dot formative element is the mechanism which can form the dot from which an ink drop is breathed out with a different flying speed, and the amount of ink differs, and the aforementioned test pattern is a print control unit which is the pattern which detects a position gap of the dot formed of the ink drop breathed out with a different flying speed the account of before.
[Claim 5] It is a print control unit according to claim 1, and the aforementioned printing section is equipped with the dot formative element in the direction of vertical scanning in the pitch of k raster (k is the two or more natural numbers). the aforementioned printing control data The print control unit which is data which make the test pattern which detects a gap of the dots which were made to perform vertical scanning in the aforementioned printing section with the feed per revolution of an s-k/m (natural number or 1 which m has in the two or more natural numbers, and has m and relatively prime relation as for s) raster, and were formed with m kinds of time print.
[Claim 6] It is the print control unit which is the pattern with which a dot is formed at the interval from which it is a print control unit according to claim 1, and the dots by which the aforementioned test pattern adjoins in the direction of vertical scanning are separated.
[Claim 7] It is the print control unit which is data in which the aforementioned test pattern is made to form using some elements with which it is a print control unit according to claim 6, and the aforementioned printing control data does not adjoin mutually among two or more aforementioned dot formative elements.
[Claim 8] The print control unit which it has in the correction directions data generation section which is a print control unit according to claim 1, and generates a timing specification means by which a user specifies the drive timing of the aforementioned dot formative element in each time by the relation with the aforementioned test pattern, and the correction directions data made to correct the drive timing of the aforementioned dot formative element to the this specified timing as data which supply the aforementioned printing section further.
[Claim 9] the printing section which forms a dot by two or more dot formative elements from which the position of the direction of vertical scanning differs, performing horizontal scanning and vertical scanning, and a claim 1 or a claim -- the printer equipped with the print control unit of a publication 7 either
[Claim 10] It is the printer which is characterized by providing the following and which it is a printer, and the aforementioned print control unit is equipment according to claim 8, and is equipped with the drive timing correction section which corrects the drive timing of an account dot formative element according to the correction directions data with which the aforementioned print control unit generates the aforementioned printing section further. The printing section which forms a dot by two or more dot formative elements from which the position of the direction of vertical scanning differs, performing horizontal scanning and vertical scanning The print control unit which controls operation of this printing section
[Claim 11] By the printing section which forms a dot using two or more dot formative elements from which the position of the direction of vertical scanning differs, performing horizontal scanning and vertical scanning which are characterized by providing the following It is the printing method which prints the test pattern which detects the position gap between two or more dots which drive the aforementioned dot formative element at different time, and are formed in the same pixel (a). As the aforementioned test pattern The conditions by which two or more aforementioned dots are formed in two or more pixels from which the position of the same [the position of main scanning direction] and the direction of vertical scanning differs, and the range at least of a part The process which generates the printing control data for making the pattern which fulfills the conditions into which the dot formed between the dots formed at the time of 1 at other time is inserted print by the aforementioned printing section (b) The process which drives the printing section in the first half and prints the aforementioned test pattern according to this printing control data
[Claim 12] The printing section which forms a dot by two or more dot formative elements from which the position of the direction of vertical scanning differs is used performing horizontal scanning and vertical scanning. It is the record medium recorded possible [computer reading of the program which generates the printing control data for making the test pattern which detects the position gap between two or more dots formed in the same pixel of the aforementioned dot formative element driven at different time print]. a claim 1 or a claim -- the record medium which recorded the program which realizes the function of the print control unit of a publication 8 either

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the printer and the adjustment method of suppressing the position gap of the main scanning direction of dots formed to different timing, such as a dot printed in both-way both directions of horizontal scanning.
[0002]
[Description of the Prior Art] Conventionally, the ink jet printer which prints by breathing out ink from a head as an output unit of a computer has spread. Reciprocating a head to print media as horizontal scanning, it breathes out multicolor ink and an ink jet printer forms a dot. In order to improve recording rate, there are some which form a dot during movement of both-way both directions in main scanning direction in an ink jet printer (this record method is hereafter called bidirectional record). In this case, in order to print a good picture, it is necessary to make in agreement the position of the main scanning direction of the dot formed at the time of ****, and the dot formed at the time of double action. If a relative gap of the dot at the time of **** and double action arises, a rough deposit will arise in a picture and quality of image will deteriorate. In order to suppress this gap, adjustment using the test pattern is performed.
[0003] Drawing 24 is explanatory drawing showing an example of the conventional test pattern. Here, the pattern formed of the head HD equipped with five nozzles was illustrated. The position of the direction of vertical scanning of the head HD at the time of **** was shown in the left-hand side of drawing, and the position of the direction of vertical scanning of the head HD at the time of double action was shown in right-hand side. "-" showed the dot formed in the dot formed in the center at the time of **** at the time of "0" and double action. By the conventional test pattern, the dot was formed by ****, and after performing vertical scanning by feed-per-revolution L equivalent to the integral multiple N of the nozzle pitch k, the dot was formed by double action. Under the present circumstances, at the time of double action, the ** timing which breathes out ink to each pixel was shifted on several step story, the relative physical relationship of the dot at the time of **** and double action was changed, and the dot was formed. The case where it shifted in five stages of numbers 1-5 drawing was illustrated. By seeing the test pattern printed in this way, and choosing the optimal timing, a user can adjust the **** timing of ink so that there may be no position gap of the dot of a round trip. In the example of drawing, in the timing of a number 3, since the dot position of a round trip is in agreement, it will be said that this timing is the optimal.
[0004] Although high definition-ization is attained when a printer in recent years prints by high resolution using a very detailed dot, since use of a detailed dot leads to the fall of a print speed, it is anxious for improvement in the quality of image in bidirectional record from a viewpoint which improves a print speed. However, in performing bidirectional record, a slight gap of the formation position of a dot tends to influence quality of image greatly. For example, in a return trip, in case a head carries out horizontal scanning to the right from the left, when it has the property that the position of a dot shifts to left-hand side, since horizontal scanning is carried out to an opposite direction, the position of a dot will shift to right-hand side. Consequently, the gap produced in one of round trips will be doubled by performing bidirectional record. Thus, in

bidirectional record, since degradation of the quality of image by the maladjustment of the dot position of a round trip became intense, a method of adjusting the formation timing of a dot with an easily and sufficient precision was desired.
[0005] Moreover, it was found out that the effect that quality of image improves is acquired, so that it was equal to attaining high resolution-ization of several step story, when adjusting precisely the position gap of the dot at the time of **** and double action in bidirectional record as a result of a minute experiment of these people and examination. Although the manufacturing cost of a printer will increase if a detailed dot tends to be formed and it is going to attain high resolution-ization, the improvement in the quality of image by doubling the position of a round trip precisely is easy, and very effective at the point which does not cause this evil. It was anxious for the method of adjusting [in / bidirectional record / from this background] a position gap of a dot with a sufficient precision easily.
[0006]
[Problem(s) to be Solved by the Invention] However, by the test pattern shown in drawing 24 , the formation position of a dot was not able to be adjusted with so sufficient that these demands are balanced a precision. Drawing 25 is explanatory drawing expanding and showing the actually formed example of a test pattern. **** timing is changed in 15 stages of numbers 1-15, and the dot is recorded. The test pattern serves as a dot in which the upper part of a dot train and the lower part were formed in either the outward trip or the return trip, respectively, and the dot train formed in the outward trip and the return trip near the center has piled up. According to the test pattern of drawing 25 , it is recognized that the range of about four to nine number is desirable formation timing. However, it is very difficult to specify which timing is the optimal. Thus, by the conventional test pattern, it was difficult to adjust the formation position of a dot with a sufficient precision. Although the case where it printed in the resolution which is a grade which can check each dot by looking here was illustrated, when carrying out printing in high resolution to the grade which forms the straight line in which the dot train continued in the direction of vertical scanning, it was more difficult still to specify the optimal formation timing.
[0007] Although the demand was high in bidirectional record, especially the method of adjusting the formation position of a dot with a sufficient precision is not restricted to these, and was similarly demanded in adjustment between the heads of a color which is different, adjustment of the dots from which the amount of ink differs, etc. this invention is made in view of this technical problem, and aims at offering the technology of adjusting easily the position of the main scanning direction of the dot formed to different timing with a sufficient precision.
[0008]
[A The means for solving a technical problem, and its operation and effect] In order to solve a part of above-mentioned technical problem [at least], the next composition was adopted in this invention. By namely, the printing section which forms a dot using two or more dot formative elements from which the position of the direction of vertical scanning differs, performing horizontal scanning and vertical scanning In the print control unit which generates the printing control data for making the test pattern which detects the position gap between two or more dots which drive the aforementioned dot formative element at a different stage, and are formed in the same pixel print In the conditions by which two or more aforementioned dots are formed in two or more pixels from which the aforementioned test pattern differs in the position of the same [the position of main scanning direction], and the direction of vertical scanning, and the range at least of a part It shall be the pattern which fulfills the conditions into which the dot formed between the dots formed at the stage of 1 at other stages is inserted. The printing section receives the printing control data generated by the print control unit, and performs printing of the above-mentioned test pattern.
[0009] Various cases are mentioned when time is set in one horizontal scanning when ink is breathed out by different horizontal scanning to one pixel from a different stage, and ink is breathed out. Therefore, when the aforementioned printing section is the printing section which can form a dot in the both sides at the time of **** of horizontal scanning, and double action, the aforementioned test pattern shall be a pattern which detects a position gap of the dot formed at the time of **** and the dot formed at the time of double action.

[0010] Moreover, after having been arranged by the direction of vertical scanning, and main scanning direction two-dimensional, when the aforementioned printing section is equipped with the dot formative element, the aforementioned test pattern shall be a pattern which detects a position gap of the dot formed of the dot formative element from which the position of main scanning direction differs. When it has multicolor ink as a state arranged two-dimensional here, for example, the case where a dot formative element is arranged for every color, and the dot formative element of a color of horizontal scanning or vertical scanning which is arranged by ** on the other hand and is different is arranged in the other directions is mentioned. Moreover, two or more trains preparation of the dot formative element of the same color may be carried out not only at the direction of vertical scanning but at main scanning direction.
[0011] Moreover, when it is the mechanism which can form the dot from which an ink drop is breathed out with the flying speed from which the aforementioned dot formative element differs, and the amount of ink differs, the aforementioned test pattern shall be a pattern which detects a position gap of the dot formed of the ink drop breathed out with a different flying speed the account of before. The case where formation of the dot from which the amount of ink differs is enabled is mentioned by the flying speed's making possible continuously the regurgitation of a quick ink drop and a late ink drop to one pixel as this dot formative element, and using these alternatively. Of course, the regurgitation may not necessarily be continuously possible to one pixel.
[0012] By the test pattern of this invention, since a dot is formed in a pixel with the same position of main scanning direction, the dot train extended in the direction of vertical scanning is formed. Under the present circumstances, since the positions of the direction of vertical scanning of each dot differ, dots do not overlap completely. Moreover, since there is a range into which the dots formed at a different stage are inserted mutually, if these dots are formed in the proper position, the dot train located in a line in a straight line will be formed in the direction of vertical scanning. On the other hand, when a gap is in a formation position, a dot train is formed, after the so-called backlash has arisen, the state [straight line] gradually shifted and. According to the above-mentioned test pattern, it becomes possible to adjust a formation position with an easily and sufficient precision by the existence of such a backlash.
[0013] Drawing 1 is explanatory drawing showing an example of a test pattern. As the conventional technology showed, the case where the dot at the time of **** (dot shown by "O") and the dot at the time of double action (dot shown by "-") were formed was illustrated by five dot formative elements arranged in the direction of vertical scanning. Here, five dot trains to the numbers 1-5 which changed the drive timing of the dot formative element at the time of double action into five stages, and were formed are shown. Since each dot train is the test pattern which fulfills the conditions of this invention, it does not matter as what prints only a single tier. Since the dot is formed in the proper position, by the number 3, the straight dot train is formed in the direction of vertical scanning, as illustrated. By numbers 1, 2, 4, and 5, since a gap is in a formation position, it is a dot train accompanied by a backlash. A dot can be formed in a proper position by adjusting double-acting drive timing to the state of No. 3.
[0014] Drawing 2 is explanatory drawing showing the example of the actually printed test pattern. It prints on the same conditions as the test pattern shown in drawing 25 in the conventional technology. When there is a gap of formation positions, such as a number 1 and a number 15, as illustrated, the backlash of a dot train is checked by looking notably. On the other hand, to the timing of numbers 5-7, it turns out that there are few backlashs and the dot train is mostly formed in the shape of a straight line. And if it observes more delicately, it is specified that the number 6 forms the dot train which was most excellent in linearity. Thus, by the conventional test pattern, although the optimal timing was not able to be specified among the numbers 4-9 in drawing 25 , according to the test pattern of this invention, it becomes possible to specify the optimal timing.
[0015] It is thought that the reason the test pattern of this invention becomes easier to detect the existence of a gap of the formation position of a dot is mainly based on the following factor. By the conventional test pattern (refer to drawing 24 and drawing 25), the dots of a round trip lap, consequently a dot train comes to be thinly checked by looking as a gap of the formation

position of a dot becomes small. That is, it can be said that the conventional test pattern was what distinguishes the existence of a gap of a formation position by making the size of a dot train into an index. However, since human being's visual sense is comparatively insensible about the difference of a size, a delicate gap is undetectable with a sufficient precision. Moreover, if a gap of a formation position becomes small and dots come to lap, in the portion with which the dot lapped, it will become easy to produce bleeding. In order that this bleeding may act in the direction which makes a dot train thick, it is hard coming to distinguish a gap of a formation position increasingly. On the other hand, the test pattern of this invention distinguishes a gap of a formation position according to the grade of the backlash of a dot train. Generally, to the existence of a backlash, since it is very sensitive, the precision of the visual sense of human being which detects the existence of a gap improves.
[0016] In addition, although the test pattern using the dot formed at the time of **** and double action was illustrated in drawing 1 and drawing 2 , the test pattern of this invention can be applied among the various dots formed at a different stage besides in this case. Moreover, it is also possible to apply between the dots formed with three or more kinds of stages, such as between the dots formed by three or more dot formative elements from which limitation is not carried out between the dots formed with two kinds of stages, but the position of main scanning direction differs. Moreover, although the case where a dot was formed in the direction of vertical scanning at equal intervals was illustrated in drawing 1 and drawing 2 , it is not necessary to be necessarily regular intervals.
[0017] Although the feed per revolution of vertical scanning for forming the test pattern of this invention can be set up suitably When it has the dot formative element in the direction of vertical scanning in the pitch of k raster (k is the two or more natural numbers), the aforementioned printing section the thing which the aforementioned printing control data makes perform vertical scanning in the aforementioned printing section with the feed per revolution of an s-k/m (natural number or 1 which m has in the two or more natural numbers, and has m and relatively prime relation as for s) raster -- then The test pattern which detects a gap of the dots formed with m kinds of stages can be made to print. In this case, the test pattern by which each dot was arranged at equal intervals in the direction of vertical scanning is realized.
[0018] Since the test pattern of this invention is what detects a gap of a formation position by the existence of the backlash of a dot train, it is more desirable that each dot can be checked by looking individually. As for this viewpoint to a test pattern, it is desirable that they shall be the pattern with which a dot is formed at the interval from which the dots which adjoin in the direction of vertical scanning are separated, and the pattern which will avoid contact or duplication of dots and will be formed if it puts in another way. Of course, it is not limited to these patterns.
[0019] Fully, to a latus case, even if the interval of the dot formative element arranged in the direction of vertical scanning forms a dot using all dot formative elements, it can avoid duplication of adjoining dots. On the other hand, when the interval of a dot formative element is comparatively narrow, duplication of dots may arise. In this case, it is good also as what forms the aforementioned test pattern using some elements which do not adjoin mutually among two or more dot formative elements. If it carries out like this, even when using the dot formative element which pointed to printing by high resolution and was arranged very densely, the test pattern with a sufficient precision which can be adjusted can be formed for a formation position.
[0020] Adjustment of the drive timing of the printing section Printing of this test pattern, Although you may carry out by repeating and performing adjustment of the drive timing of the printing section A timing specification means by which a user specifies the drive timing of the aforementioned dot formative element in each stage as a print control unit by the relation with the aforementioned test pattern further, It is also desirable to have the correction directions data generation section which generates the correction directions data made to correct the drive timing of the aforementioned dot formative element to the this specified timing as data supplied to the aforementioned printing section. If it carries out like this, based on this correction directions data, the drive timing of the printing section can be immediately adjusted to suitable timing. It is also desirable to equip the printing section with a means to correct the drive

timing of a dot formative element, in response to these correction directions data. Of course, it is good also as what performs control which doubles the drive timing of a dot formative element with the timing which the user specified when it can control directly by the print control unit.
[0021] this invention can consist of modes of a printer equipped with the printing section and a print control unit, the printing control method, and the printing method as invention which makes the same others, this, and the principal part. [mode / as a print control unit mentioned above]
[0022] moreover, the above -- it can also constitute as a record medium recorded possible [computer reading of the program for a computer realizing the function of these] Here, as a record medium, computers, such as internal storage (memory, such as RAM and ROM) of the printed matter with which signs, such as a flexible disk, CD-ROM and a magneto-optic disk, an IC card, a ROM cartridge, a punch card, and a bar code, were printed, and a computer, and external storage, can use the various media in which read is possible. In addition to this, this invention can also be constituted as the program itself which realizes the above-mentioned function or the data of a test pattern, and various signals which can carry out the isopia to this.
[0023]
[Embodiments of the Invention] The gestalt of operation of this invention is explained in order of the following based on an example.
A. composition [of equipment]: -- B. dot formation timing adjustment processing: -- C. 2nd example: -- D. 3rd example: -- 1st modification [of the E. 3rd example]: -- 2nd modification:
[0024] of the F. 3rd example A. Composition of equipment : drawing 3 is explanatory drawing showing the printing structure of a system as an example. This printing system connects Printer PRT and Computer PC by Cable CB, and is constituted. Printer PRT is the so-called ink jet printer, and a picture is printed by breathing out ink and forming a dot, performing horizontal scanning and vertical scanning. Computer PC generates the printing control data which specifies operation of Printer PRT, and transmits it to Printer PRT. The raster data which specify turning on and off of a dot about each pixel on a raster, and the feed-per-revolution data which specify the feed per revolution of vertical scanning are contained in printing control data. Printing control data is generated by performing software with which Computer PC is called printer driver.
[0025] It is also possible by connecting Computer PC to the external network TN, and connecting with the specific server simian virus to download the program and data for driving Printer PRT. Moreover, it is also possible to load a required program and required data from record media, such as a flexible disk and CD-ROM, using a flexible disk drive FDD or CD-ROM drive CDD. Naturally, these programs can also take the mode which loads the whole program required for printing collectively, and can also take the mode which loads a part of functions as a module.
[0026] Drawing 4 is explanatory drawing showing functional block of the printing system of an example. By Computer PC, the application program 95 is operating under a predetermined operating system. The printer driver 96 is included in the operating system. An application program 95 processes generation, a retouch, etc. of a picture.
[0027] A printer driver 96 inputs the printing instruction from the command and application 95 from a keyboard 14 etc. through the input section 100. The kind of input responds and a printer driver 96 performs the following processings, respectively. First, to the printing instruction from an application program 95, image data is received from an application program 95, and the printing control data which usually controls operation of Printer PRT by the printing module 101 is generated. Usually, the printing module 101 performs color transform processing which changes the color component of image data into the color component according to the ink of Printer PRT, and half toning which expresses the gradation value of image data by the distribution of a dot, and arranges it to the predetermined format which transmits the obtained data to Printer PRT with the feed-per-revolution data of vertical scanning. In this way, the generated printing control data is transmitted to Printer PRT from the output section 104.
[0028] As one of the processings which a printer driver 96 performs to the directions from a keyboard 14, the processing which adjusts the formation timing of the dot of Printer PRT is mentioned. If adjustment processing of formation timing is directed, a printer driver 96 will print a

test pattern with the test pattern printing module 102 according to the test pattern data 103 memorized beforehand. The printing control data for printing a test pattern is outputted to Printer PRT from the output section 104. The test pattern data 103 are prepared in the same form as the image data which the printing module 101 usually deals with, and this example is available also as what performs color transform processing, half toning, etc. by the test pattern printing module 102, and generates printing control data, although the data which can be transmitted direct were prepared for Printer PRT as test pattern data 103.
[0029] The input section 110 receives the printing control data transmitted from the printer driver 96, and Printer PRT once memorizes it to a buffer 115. And according to the printing control data memorized by the buffer 115, the horizontal-scanning section 111 and the vertical-scanning section 112 perform horizontal scanning of a head, and conveyance of a print sheet, and the head mechanical component 113 drives a head and prints a picture. Printer PRT can form a dot on the both sides at the time of **** of horizontal scanning, and double action. The timing which drives a head is memorized by the drive timing table 114.
[0030] In adjusting formation timing of a dot, based on the printing result of a test pattern, a user specifies the optimal timing from a keyboard 14. A printer driver 96 outputs the control signal of the purport adjusted to the formation timing into which specification of formation timing was inputted into through the input section 100, and the drive timing table 114 was inputted to Printer PRT. If this data is inputted, the input section 110 of Printer PRT will rewrite the drive timing table 114, and will change the formation timing of a dot. In addition, although the case where Printer PRT printed a test pattern etc. was illustrated according to the printing control data which Computer PC generates here, it is good also as what includes the function which Computer PC achieves in Printer PRT side.
[0031] Drawing 5 is explanatory drawing showing the outline composition of Printer PRT. Printer PRT consists of the circuit which conveys Form P by the ejection motor 23, a circuit which makes carriage 31 reciprocate to the shaft orientations of a platen 26 by the carriage motor 24, a circuit which drives the print head 28 carried in carriage 31, and performs the regurgitation of ink, and dot formation, and a control unit 40 which manages an exchange of a signal with these ejection motors 23, the carriage motor 24, a print head 28, and a control panel 32 so that it may illustrate.
[0032] The circuit which makes carriage 31 reciprocate to the shaft orientations of a platen 26 consists of position detection sensor 39 grades which detect the sliding shaft 34 which is constructed in parallel with the shaft of a platen 26, and holds carriage 31 possible [sliding], the pulley 38 which stretches the endless driving belt 36 between the carriage motors 24, and the home position of carriage 31.
[0033] the carriage 31 of this printer PRT -- the cartridge 71 for black ink (K), cyanogen (C), light cyanogen (LC), a Magenta (M), a light Magenta (LM), and a yellow -- the cartridge 72 for color ink which contained the ink of five colors of (Y) can be carried A total of six heads 61-66 for ink regurgitation are formed in the print head 28 of the lower part of carriage 31. The ink path 68 which leads the ink from an ink tank to each of this head for colors is established in the pars basilaris ossis occipitalis of carriage 31.
[0034] Drawing 6 is explanatory drawing showing the array of the nozzle Nz in the heads 61-66 for ink regurgitation. Each nozzle Nz is equivalent to a dot formative element. Arrangement of these nozzles consists of 6 sets of nozzle arrays which carry out the regurgitation of the ink of each color, and is alternately arranged in the nozzle pitch k with 48 fixed nozzles Nz. The position of the direction of vertical scanning of each nozzle array is mutually in agreement. Each head will have the nozzle train of two trains in main scanning direction. In this example, the nozzle pitch k is an interval equivalent to the resolution of 90DPI.
[0035] Drawing 7 is explanatory drawing showing the formation principle of the dot by the head 28 for ink regurgitation. The portion which carries out the regurgitation of the ink of black ink (K), cyanogen (C), and Rheydt Singh (LC) was shown on account of illustration. Piezo-electric element PE is arranged for every nozzle at heads 61-66. When predetermined voltage is impressed to the electrode prepared in the ends of piezo-electric element PE, as an arrow shows all over drawing, piezo-electric element PE elongates only the impression time of voltage,

and the unilateral wall of the ink path 68 is made to transform. Consequently, the volume of the ink path 68 contracts and the ink drop Ip is breathed out.

[0036] Next, the internal configuration of a control unit 40 is explained. Drawing 8 is explanatory drawing showing the internal configuration of a control unit 40. The various circuits shown in the interior of a control unit 40 below focusing on CPU41, PROM42, and RAM43 are mutually connected by bus 48. The PC interface 44 exchanges data with Computer PC. The circumference I/O section (PIO) 45 exchanges a signal with the ejection motor 23, the carriage motor 24, a control panel 32, etc. A clock 46 takes the synchronization of operation of each circuit. The buffer 47 for a drive outputs the signal of turning on and off of the dot for every nozzle on heads 61-66 to the driving-signal generation section 55.

[0037] The transmitter 50 is connected to the driving-signal generation section 55. A transmitter 50 outputs periodically the clock signal used as the criteria which generate a driving signal. The driving-signal generation section 55 generates the drive wave outputted to each nozzle train of heads 61-66 based on the signal from a transmitter 50. Since it has 12 nozzle trains from which the position of main scanning direction differs, the driving-signal generation section 55 shifts timing on heads 61-66 for every nozzle train, and outputs a driving signal to them so that a dot can be formed suitable for each pixel as already explained. in order that [moreover,] Printer PRT may perform bidirectional record -- the output timing of a driving signal -- if it puts in another way, the formation timing of a dot is individually set up in the time of **** of horizontal scanning, and double action The output timing of a driving signal is memorized by PROM42.

[0038] Here, the meaning of the output timing of a driving signal is explained. The output timing of a driving signal is specified at an interval with a PTS signal. It is the signal outputted to each pixel corresponding to a PTS signal, and is a signal used as the criteria of output timing. Drawing 9 is explanatory drawing showing generation of a PTS signal. The Linear Scale by which the portion black-lacquered at a predetermined interval was equally given to the sliding shaft 34 of Printer PRT is prepared. In this example, the width of face of a black painting portion is the interval of 360DPI equivalent to the double precision of the printing resolution of main scanning direction. Carriage 31 is equipped with the photo sensor 73, and the signal of turning on and off is outputted according to whether the field where a sensor counters at the time of movement of carriage 31 is the black painting section. The situation of this signal was shown all over drawing. A control unit 40 can detect the position of the main scanning direction of carriage 31 by this pulse.

[0039] By carrying out the division-into-equal-parts rate of the pulse outputted from the sensor, the position of carriage 31 is detectable in the resolution more than the resolution of the black painting section. If the interval of the aforementioned pulse is equally divided into two, the position of carriage 31 is detectable in the resolution of 720DPI. In this way, as for the acquired signal, the relation between carriage 31 and a pixel is kept constant. In printing in 720DPI, the signal acquired by doing in this way turns into a PTS signal. All over drawing, the example of the PTS signal corresponding to 720DPI was shown. In addition, a PTS signal can also be generated based on the pulse outputted to the motor, when it can also output by the fixed time period from the start of others and horizontal scanning and carriage is driven with the stepping motor, although generated using an optical sensor in this way.

[0040] What is necessary is just to carry out the regurgitation of the ink based on the PTS signal A, in case a dot is formed in a certain pixel PP on an outward trip. What is necessary is just to carry out the regurgitation of the ink based on the PTS signal B in a return trip. What is necessary is to vacate a predetermined interval from a PTS signal and just to carry out the regurgitation of the ink so that it is not necessary to carry out the regurgitation of the ink simultaneously with the output of a PTS signal and a dot can be formed at Pixel PP in any case. The interval from the PTS signal used as criteria to the output of a driving signal is called output timing of a driving signal on these specifications.

[0041] Drawing 10 is explanatory drawing showing change of the formation position of the dot by change of output timing. The situation when carriage is moving to drawing 10 (a) rightward was shown. A dot will be formed in the position shown in No. 1 of drawing if a driving signal is outputted to the output timing in which only time deltat was from PTS. If the value of output

timing deltat is enlarged gradually, since the timing which carries out the regurgitation of the ink will be overdue, the formation position of a dot shifts rightward gradually as the numbers 1-5 in drawing show it. The situation when carriage is moving to drawing 10 (b) leftward was shown. A dot will be formed in the position shown in No. 5 of drawing if a driving signal is outputted to the output timing in which only time deltat was from PTS. If the value of output timing deltat is enlarged gradually, the formation position of a dot will shift leftward gradually. that is, what is necessary is for what is necessary to be just to delay formation timing in the state where carriage is moving rightward and just to bring formation timing forward in the state where carriage will go leftward and where it is carrying out to shift the formation position of a dot on right-hand side

[0042] The formation position of a dot can be adjusted by the printing system of this example being able to print a picture and a test pattern, and adjusting the output timing of a driving signal by the equipment configuration explained above.

[0043] B. Explain the content of processing for adjusting formation timing of a dot in dot formation timing adjustment processing:, next bidirectional record. This adjustment is performed by performing the dot formation timing adjustment manipulation routine of a printer driver 96. Drawing 11 is the flow chart of dot formation timing adjustment processing. This processing is processing which CPU of Computer PC performs. In this example, formation timing at the time of **** and double action is adjusted using the dot of black (K).

[0044] If dot formation timing adjustment processing is started, CPU will generate the printing control data for printing a test pattern, and will output it to Printer PRT (Steps S100 and S105). The raster data which pinpoint the position which forms a dot at the time of ****, the feed-per-revolution data which specify the feed per revolution of vertical scanning, and the raster data for double action are generated and outputted based on the test pattern data memorized beforehand.

[0045] The test pattern used by this example is shown in drawing 1 . Here, the pattern to the head equipped with five nozzles in the direction of vertical scanning was illustrated. At the time of ****, a dot is formed in the position shown by "O" in drawing as already explained. Each test pattern of numbers 1-5 is formed at intervals of the grade which there is not with a heavy bird clapper mutually and can be discriminated easily. In an outward trip, a dot is formed to fixed timing to PTS. The dot of a return trip is formed as vertical scanning is performed by feed-per-revolution L equivalent to the half of the nozzle pitch k and "-" shows, when it finishes forming the dot at the time of ****. The dot of a return trip will be formed in the middle of the dot of an outward trip. Moreover, in a return trip, formation timing is changed to several step story to PTS, and a dot is formed. Here, the case where it was made to change to five stages was illustrated. Consequently, the relative formation position of the dot of a round trip changes gradually. In addition, an identification number is given to the printed test pattern for every timing as numbers 1-5 are attached in drawing 1 . In this example, the dot at the time of **** and the dot at the time of double action form the dot train arranged by turns as a test pattern in this way.

[0046] The actually printed example of a test pattern is shown in drawing 2 . Here, the feed per revolution was set up by half x odd time" of "nozzle pitch k. For this reason, the upper part of each test pattern serves as only a dot formed on the outward trip, and the lower part serves as only a dot formed in the return trip. The dot formed both ways near the center is formed in the direction of vertical scanning by turns. A feed per revolution is the range in which the field where the dots formed both ways are intermingled exists, it can choose various values so that both may not lap, and it should just set them up suitably so that a user may tend to detect a position gap of a dot. Although half x odd time" of "nozzle pitch k may be set up by one third of not not necessarily required conditions but the nozzle pitches k etc., if it sets up by half x odd time" of "nozzle pitch k, since the dot of a round trip will be arranged at equal intervals, there is an advantage which is easy to detect a gap of a formation position.

[0047] In this way, if a test pattern is printed, CPU will read waiting and its result for formation timing being specified by the user (Step S110). At this example, formation timing shall be specified with the identification number given to the test pattern. Based on the printing result of a test pattern, a user chooses timing with few relative gaps of the dot of a round trip, and inputs

the identification number. In the example of drawing 1 , since the timing of a number 3 corresponds to the optimal timing, an identification number 3 is inputted into a computer using input devices, such as a keyboard.
[0048] In this way, if formation timing is specified, CPU will output the control signal of the purport which adjusts the drive timing memorized by PROM of Printer PRT to the value equivalent to the specified formation timing (Step S115). Printer PRT receives this control signal and changes the drive timing data memorized by PROM in a control unit 40. If drive timing data are changed, from the time of the next printing, the interval from a PTS signal to a driving signal will be changed, and where a relative gap of a round trip is adjusted, a dot will be formed.
[0049] According to the printing system of this example explained above, the formation position of a dot can be made both ways in agreement with a sufficient precision by using the test pattern of the form shown in drawing 1 and drawing 2 . That is, in the printing system of this example, based on the linearity of the dot train of the direction of vertical scanning, a gap of a formation position is detectable, and since human being's visual sense is sensitive coldhearted about this linearity, a formation position can be adjusted with a sufficient precision.
Consequently, according to the printing system of this example, the rough deposit of a picture can be suppressed and quality of image can be improved greatly.
[0050] In the above-mentioned example, various formation timing was made to change, the test pattern was printed, and the case where formation timing was specified in a user inputting an identification number was illustrated. Adjustment of formation timing is not limited to the method of starting. For example, it is good also as what shall print a test pattern to single timing, repeats and performs specification of formation timing, and printing of a test pattern, and adjusts formation timing gradually.
[0051] C. The 2nd example : in the 1st example, the case where 90DPI deserved the nozzle pitch of the direction of vertical scanning was illustrated. Since the printer PRT of this example realized printing in the resolution of 720DPI, the nozzle pitch of the direction of vertical scanning was a several times coarser pitch to resolution, as drawing 9 explained. On the other hand, in the 2nd example, when the nozzle pitch of the direction of vertical scanning is narrow, if it puts in another way, printing of a test pattern and the adjustment method of formation timing will be explained about the case where the nozzle is arranged by high density in the direction of vertical scanning.
[0052] Drawing 12 is explanatory drawing which illustrates the test pattern using the nozzle arranged by high density. Here, the case where the nozzle was arranged in 360DPI of half resolution was illustrated to printing resolution 720DPI of the direction of vertical scanning. Like the 1st example, if a test pattern is printed using all nozzles, a dot is formed without producing the omission of a raster both ways, and a dot train will continue in the direction of vertical scanning, and will form one line. However, if the test pattern shown in the 1st example is formed so densely that a dot train is checked by looking as one line in this way since a gap of a formation position is detected by whether a backlash is in the linearity, i.e., the dot train, of a dot, it will be hard coming to detect the existence of a backlash, and the adjustment precision of a formation position will fall. In the nozzle high-density [in this way] and arranged, the printing system of the 2nd example is the mode shown below, and prints the test pattern with a sufficient precision which can adjust a formation position.
[0053] Drawing 13 is explanatory drawing showing the formation method of the test pattern in the 2nd example. Here, the case where a head equipped with ten nozzles was used was illustrated. Moreover, only the pattern corresponding to single formation timing was shown. The nozzle number to #1-#10 was given to the expedient top of explanation, and the nozzle. Although the hardware composition and functional block of a printing system in the 2nd example are almost the same as the 1st example (refer to drawing 3 - drawing 8), it is different in that the nozzle pitch k serves as 360DPI.
[0054] In the 2nd example, a test pattern is printed only using some nozzles not using all the nozzles with which the head was equipped. Hatching was attached and illustrated for the nozzle which is not used for printing. In the example of drawing, three nozzles, #1, #5, and #9, are used for printing. The nozzle to be used is chosen under the conditions which do not adjoin mutually.

Although the fixed interval was opened and chosen in the 2nd example, you may choose at intervals of an inequality. In this way, by printing a test pattern using the selected nozzle, a test pattern equivalent to having made coarse the nozzle pitch of the direction of vertical scanning, and having been formed can be printed seemingly. In the illustrated example, by choosing the nozzle of #1, #5, and #9, these nozzle pitches k1 will be 4 times the nozzle pitch k, and become the head and equivalence which were equipped with the nozzle at intervals of 90DPI seemingly. If feed-per-revolution L is set as the half of the nozzle pitch k1 on appearance, the same test pattern as the 1st example can be printed.
[0055] Thus, the test pattern which thins out and uses a nozzle is easily realized by memorizing test pattern data in form of specifying the state after printing as a picture. It is the stage where the printing control data for printing a test pattern will be generated if the picture itself by which a dot is arranged at the interval shown in drawing 13 is memorized as test pattern data, and the illustrated test pattern can be realized, without carrying out special processing, since the mask data which means the agenesis of a dot is set as nozzle #2-#4 which scan the raster in which a dot is not formed.
[0056] Otherwise, formation of the test pattern of the 2nd example is realizable with various control processings. For example, the pattern which forms a dot is memorized on the test pattern with all nozzles, and the nozzle which is not chosen as the generate time of printing control data is good for it also as what carries out the mask of the nozzle which does not replace data or is not chosen by Printer PRT side so that a dot may not be formed.
[0057] According to the printing system of the 2nd example, as shown in drawing 13 , resolution of the direction of vertical scanning can be made coarser than a nozzle pitch, and a test pattern can be printed. In this way, according to the printing system of the 2nd example, by adjusting a formation position using the printed test pattern, a formation position can be easily adjusted with a sufficient precision also in the printer by which a nozzle is equipped with the head arranged by high density. although the formation position will be strictly adjusted about the nozzle which is not chosen, the nozzle train arranged in the direction of vertical scanning is constituted so that it may drive to the same timing -- usually -- coming out -- being certain -- since -- if timing is adjusted with some nozzles, it will come out enough
[0058] In addition, in the 2nd example, vertical scanning shall be performed with the feed per revolution of the half of the nozzle pitch k1 on appearance, and a test pattern shall be printed. On the other hand, it is good also as what changes the nozzle used both ways and prints the same test pattern. Drawing 14 is explanatory drawing showing the test pattern formation method as a modification of the 2nd example. In the modification, after forming a dot by ****, a dot is formed by double action, without performing vertical scanning. However, to using the nozzle of #1, #5, and #9 at the time of ****, the nozzle to be used is changed into #3 and #7 at the time of double action, and it forms a dot. The test pattern of the 2nd example is possible also for forming by the method of starting, and if this test pattern is used, it can acquire the same effect as the 2nd example explained. Of course, it is also possible to form a test pattern, combining change and vertical scanning of a nozzle to be used suitably.
[0059] D. The 3rd example : the 1st example and the 2nd example illustrated adjustment of the formation timing in bidirectional record. In addition to this, this invention can also be applied, when performing one-way record. The case (it is hereafter called adjustment between trains) where it applies to adjustment of the formation position of the dot by different nozzle train as an example of application to the case where one-way record is performed is explained.
[0060] The hardware composition of the printing system in the 3rd example is the same as the 1st example and the 2nd example. The head of Printer PRT is equipped with the nozzle train of two trains for every color at main scanning direction as drawing 6 explained. In the following explanation, one side will be called 0 train side and another side will be called 1 train side. Since the position of main scanning direction is different, as for the nozzle train of two trains, the formation timing of a dot has shifted.
[0061] Drawing 15 is explanatory drawing showing the concept of adjustment between trains. Carriage shall move rightward in drawing. Signs that a PTS signal, the driving signal by the side of 0 trains, and the driving signal by the side of 1 train were outputted above the drawing were

shown. Down the drawing, the position of the main scanning direction of the carriage in the time of the driving signal by the side of 0 trains and the driving signal by the side of 1 train being outputted was shown. From the nozzle by the side of 0 trains, the ink drop lp0 is breathed out as it is shown in the timing A in drawing, when the driving signal by the side of 0 trains is outputted to predetermined timing to a PTS signal. Then, carriage moves rightward, and if the driving signal by the side of 1 train is outputted when the nozzle by the side of 1 train arrives at the position which is mostly in agreement with the nozzle location by the side of 0 trains in Timing A (timing B in drawing), the ink drop lp1 will be breathed out from the nozzle by the side of 1 train. If time difference deltat after outputting the driving signal by the side of 0 trains until it outputs the driving signal by the side of 1 train is not set as the suitable value according to the traverse speed of carriage, and the regurgitation property of the ink of 0 train side nozzle and 1 train side nozzle, a gap will arise in the formation position of the dot by each nozzle train. Adjustment between trains adjusts this gap.

[0062] Drawing 16 is explanatory drawing which illustrates the test pattern in the 3rd example. Here, the head by which 0 train side is equipped with four nozzles at five-piece and 1 train side was illustrated. The nozzle pitches k are 90DPI. The same test pattern as the 1st example can be printed by forming a dot, changing relatively the formation timing by the side of 0 trains and 1 train in this case. The example of a test pattern was shown in the right-hand side of drawing 15 . The dot in which "O" was formed with the nozzle by the side of 0 trains, and the dot in which "-" was formed with the nozzle by the side of 1 train are meant. Both are printed in the state where it was arranged by turns, in the direction of vertical scanning like the 1st example. In the 1st example, although the test pattern was formed by bidirectional printing, the pattern of the 3rd example can be printed only by performing one horizontal scanning to an one way.

[0063] Thus, according to the printing system of the 3rd example, the same procedure as the 1st example can adjust both formation position by making a test pattern print with the nozzle by the side of 0 trains and 1 train. Here, it illustrated about the case where it has the nozzle train of two trains for every color. The adjustment between trains is not necessarily restricted to what is performed between the same colors. Since the positions of main scanning direction differ, the nozzle train from which a color differs is set as the object of adjustment between trains, respectively, as shown in drawing 6 . For example, both formation timing can be adjusted like the thing which forms the dot of "O" in drawing 16 by 0 train side of black, and forms the dot of "-" by 0 train side of ** and cyanogen, then the 3rd example. The formation position of all nozzle trains can be adjusted by doubling one train of formation positions at a time one by one like ... 0 trains [of cyanogen], and 1 train side 1 train side of this and black on the basis of 0 train side of black.

[0064] In addition, also in adjustment between trains, a test pattern can be formed like the 2nd example, using a part of nozzle alternatively. Drawing 17 is explanatory drawing showing the example of the adjustment between trains which used a part of nozzle. When the nozzle is arranged very much by high density as illustrated, the same test pattern as the 3rd example can be formed by using the remaining nozzles which did not use the nozzle which attached hatching in drawing, but were chosen by thinning out. It can treat by thinning out and using a nozzle like the 2nd example on a par with the head seemingly equipped with a nozzle in the pitch k1 coarser than the original pitch k.

[0065] E. The 1st modification of the 3rd example : explain the case where positioning of the dots of the different amount of ink is performed as another example which adjusts the formation position of the dot formed by the one way. Here, in the **** mechanism (drawing 7) using the piezo-electric element, the case where the dot from which the amount of ink differs is formed is illustrated by changing the voltage to impress. The principle which can change the amount of ink is as follows.

[0066] Drawing 18 is explanatory drawing having shown the relation between a drive wave and the ink lp breathed out. It is the voltage waveform impressed to a piezo-electric element in the ** case to which the drive wave shown with the dashed line in drawing 18 breathes out the usual dot. Once it impresses voltage lower than reference voltage to piezo-electric element PE in the section d2, piezo-electric element PE will deform the cross section of the ink path 68 in the

increasing direction. Since there is a limitation in the speed of supply of the ink to a nozzle, the amount of supply of ink runs short to expansion of the ink path 68. Consequently, the ink interface Me will be in the state where it cratered inside Nozzle Nz as shown in the state A of drawing 18 . If voltage is rapidly made low using the drive wave shown as the solid line of drawing 18 as shown in the section d2, the amount of supply of ink will be in the state where it ran short further. Therefore, an ink interface will be in the state where it cratered inside greatly compared with State A as shown in the State a.

[0067] Next, if high voltage is impressed to piezo-electric element PE (section d3), it will deform in the direction to which a piezo-electric element makes the volume of the ink path 68 reduce, and ink will be breathed out. At this time, from the state (state A) where the ink interface is seldom cratered inside, as shown in State B and State C, a big ink drop is breathed out, and from the state (state a) to which the ink interface was cratered inside greatly, as shown in State b and State c, a small ink drop is breathed out. Thus, the size of a dot can be changed according to the rate of change at the time (sections d1 and d2) of making driver voltage low. Moreover, the flying speed of the ink drop breathed out can be adjusted by adjusting the inclination and peak value of a drive wave in the section d3.

[0068] If the drive wave of two kinds of ** which breathe out the different amount of ink is continuously outputted about each pixel, the dot from which the amount of ink differs can be chosen arbitrarily, and can be formed. Drawing 19 is explanatory drawing showing the situation of **** of a drive wave and the ink drop to each pixel. Carriage 31 is ** which breathes out an ink drop while moving to the right from the left in drawing to Form P. Two kinds in all of drive waves WS and WM are outputted to a head in this movement and timing. The drive wave WS is ****** which breathes out the small ink drop installation performance specification with few amounts of ink, and the drive wave WS is ****** which breathes out the inside ink drop IPM with many amounts of ink. A large dot can be formed by ****** which breathes both out to one pixel both. If the interval INT after outputting the drive wave WS until it outputs the drive wave WM is not set up appropriately, the formation position of a small dot and an inside dot will shift.

[0069] Drawing 20 is explanatory drawing which illustrates the test pattern for adjusting the formation position of a small dot and an inside dot in a modification. Here, it illustrated about the head equipped with ten nozzles. Nozzle number #1-#10 were given to each nozzle. A nozzle number shall form a small dot with odd nozzles (#1, 3, 5, 7, 9), and a nozzle number shall form an inside dot with even nozzles (#2, 4, 6, 8, 10). A small dot and an inside dot can print the test pattern arranged by turns in the direction of vertical scanning as illustrated by changing gradually the interval of the drive wave WS and the drive wave WM at this time. If the optimal interval is specified based on this test pattern, the formation position of a small dot and an inside dot can be adjusted. When the nozzle is arranged by high density, also in a modification, a gap of a formation position can be judged with a sufficient precision by thinning out moderately and using a nozzle like the 2nd example. Although the case where the dot of the different amount of ink was formed here was illustrated and explained, the amount of ink of the dot formed by the drive waves WS and WM may be the same.

[0070] F. The 2nd modification of the 3rd example : adjustment of the formation position of the dot of the different amount of ink is not restricted when outputting a drive wave continuously like the 1st modification. As the 2nd modification, either of two driving signals from which the amount of ink differs is alternatively explained about adjustment of formation timing when an output is possible for every pixel. Although it is good also as what enables alternatively the output of the drive waves WS and WM explained in the 1st modification, the bubble produced when ink is heated here explains taking the case of the case where the mechanism which carries out the regurgitation of the ink is adopted.

[0071] Drawing 21 is explanatory drawing showing the principle which carries out the regurgitation of the ink using a bubble. Nozzle Nz is equipped with Heater HT at the ink path as illustrated. If it energizes at this heater HT, Foam BU will arise in ink and the ink drop IQ will be breathed out by the pressure. Each nozzle NZ is equipped with two heaters, if it energizes only to one side, a small dot can be formed, and a large dot can be formed if energized by both heaters.

[0072] When the flying speed of a small dot and a large dot is different, it is necessary to adjust both formation timing. Drawing 22 is explanatory drawing showing adjustment of the formation timing in the 2nd modification. The driving signal for small dots shall be outputted from a PTS signal to predetermined timing. The ink drop installation performance specification breathed out by this driving signal reaches the pixel PP on a print sheet P by flight tracing to illustrate. On the other hand, in the case of the pixel which should form a large dot, the driving signal for large dots is outputted from a PTS signal to predetermined timing. Each dot can be formed in the same position if it sets up so that both driving signal may be outputted to the same timing when the flying speed of a small dot and a large dot is in agreement. When the flying speed of a large dot is quicker than a small dot, in order to form a dot in the same position PP, it is necessary to output the driving signal for large dots to timing later than the timing which outputs the driving signal for small dots so that it may illustrate. On the contrary, when the flying speed of a large dot is slower than a small dot, it is necessary to carry out output timing of the driving signal for large dots early. Thus, according to the difference in the flying speed of a small dot and a large dot, it is necessary to adjust the difference delta t of the output timing of each driving signal.
[0073] If the test pattern (drawing 20) shown in the 1st modification is applied also in this case, it will become possible to adjust both formation position with a sufficient precision. That is, a nozzle number shall form a small dot with odd nozzles (#1, 3, 5, 7, 9), and a nozzle number shall form a large dot with even nozzles (#2, 4, 6, 8, 10). At this time, by changing the formation timing of a large dot gradually, the test pattern shown in drawing 20 can be printed, and it becomes possible to adjust formation timing based on this test pattern.
[0074] In the above example and modification, the case where the formation position of two kinds of dots was adjusted was illustrated. Combining these, when adjusting the formation position of two or more kinds of dots, you may apply this invention. For example, while performing adjustment between trains, you may adjust a round trip. A formation position can be adjusted one by one by carrying out copy printing, changing various combination of the dot which forms the test pattern mentioned above, respectively. this invention is applicable to adjustment of the formation position between two or more dots from which the regurgitation stage of ink differs, such as a dot formed in the time of **** and double action, a dot formed in the nozzle train from which the position of main scanning direction differs, and a dot from which timing until it outputs a drive wave from a PTS signal is different.
[0075] Moreover, the test pattern of this invention is not restricted to what is formed for two kinds of dots among these. Drawing 23 is explanatory drawing showing the example which forms a test pattern for three kinds of dots. Here, the head equipped with five nozzles was illustrated. Three persons can print the test pattern arranged by turns by forming three kinds of dots formed at a different stage, for example, the dot formed with the head of three colors, in the position of the direction of vertical scanning shown by S1, S2, and S3, respectively. These are realizable by setting feed-per-revolution L as k/3 to the nozzle pitch k. It has the advantage which can adjust the formation position of a new dot, this test pattern checking that a gap does not arise again between the dots already adjusted by forming two kinds of dots which adjusted for example, the formation position by S1 and S2, and forming the dot used as the candidate for adjustment by S3. Although the case where three kinds of dots were intermingled was illustrated, you may make four or more kinds of dots intermingled here.
[0076] In the above example and modification, the case where the dot formed at a different stage was arranged by turns was illustrated. The test pattern of this invention is not limited to this mode. For example, you may form the pattern of drawing 20 in the mode inserted into two or more small dots between inside dots. That is, it is good also as what forms an inside dot with the nozzle of #1, #4, #7, and #10, and forms a small dot with the remaining nozzles. In adjusting the formation timing of dots to differ when performing adjustment between the dots from which the amount of ink differs, by giving a difference to the number of dots in a test pattern in this way, both visibility can be brought close and it becomes possible to adjust formation timing with a more sufficient precision.
[0077] As mentioned above, although the various examples of this invention were explained, it cannot be overemphasized that composition various in the range which this invention is not

limited to these examples and does not deviate from the meaning can be taken. For example, software realizes and also the above control processing is good as what is realized in hardware. Moreover, it is good also as a thing which makes Printer PRT perform the function which Computer PC had achieved in the above-mentioned example.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is explanatory drawing showing an example of a test pattern.
[Drawing 2] It is explanatory drawing showing the example of the actually printed test pattern.
[Drawing 3] It is explanatory drawing showing the printing structure of a system as an example.
[Drawing 4] It is explanatory drawing showing functional block of the printing system of an example.
[Drawing 5] It is explanatory drawing showing the outline composition of Printer PRT.
[Drawing 6] It is explanatory drawing showing the array of the nozzle Nz in the heads 61-66 for ink regurgitation.
[Drawing 7] It is explanatory drawing showing the formation principle of the dot by the head 28 for ink regurgitation.
[Drawing 8] It is explanatory drawing showing the internal configuration of a control unit 40.
[Drawing 9] It is explanatory drawing showing generation of a PTS signal.
[Drawing 10] It is explanatory drawing showing change of the formation position of the dot by change of output timing.
[Drawing 11] It is the flow chart of dot formation timing adjustment processing.
[Drawing 12] It is high-density and is explanatory drawing which illustrates the test pattern using the arranged nozzle.
[Drawing 13] It is explanatory drawing showing the formation method of the test pattern in the 2nd example.
[Drawing 14] It is explanatory drawing showing the test pattern formation method as a modification of the 2nd example.
[Drawing 15] It is explanatory drawing showing the concept of adjustment between trains.
[Drawing 16] It is explanatory drawing which illustrates the test pattern in the 3rd example.
[Drawing 17] It is explanatory drawing showing the example of the adjustment between trains using a part of nozzle.
[Drawing 18] It is explanatory drawing having shown the relation between a drive wave and the ink lp breathed out.
[Drawing 19] It is explanatory drawing showing the situation of the regurgitation of a drive wave and the ink drop to each pixel.
[Drawing 20] It is explanatory drawing which illustrates the test pattern for adjusting the formation position of a small dot and an inside dot in a modification.
[Drawing 21] It is explanatory drawing showing the principle which carries out the regurgitation of the ink using a bubble.
[Drawing 22] It is explanatory drawing showing adjustment of the formation timing in the 2nd modification.
[Drawing 23] It is explanatory drawing showing the example which forms a test pattern for three kinds of dots.
[Drawing 24] It is explanatory drawing showing an example of the conventional test pattern.
[Drawing 25] It is explanatory drawing expanding and showing the actually formed example of a test pattern.

[Description of Notations]
12 -- Scanner
14 -- Keyboard
23 -- Ejection motor
24 -- Carriage motor
26 -- Platen
28 -- Print head
28 -- Head for ink regurgitation
31 -- Carriage
32 -- Control panel
34 -- Sliding shaft
36 -- Driving belt
38 -- Pulley
39 -- Position detection sensor
40 -- Control unit
46 -- Clock
47 -- Buffer for a drive
48 -- Bus
50 -- Transmitter
55 -- Driving-signal generation section
61-66 -- Head for ink regurgitation
68 -- Ink path
71 -- Cartridge
72 -- Cartridge for color ink
73 -- Photo sensor
95 -- Application program
96 -- Printer driver
100 -- Input section
101 -- It is usually a printing module.
102 -- Test pattern printing module
103 -- Test pattern data
104 -- Output section
110 -- Input section
111 -- Horizontal-scanning section
112 -- Vertical-scanning section
113 -- Head mechanical component
114 -- Drive timing table
115 -- Buffer

[Translation done.]